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Wind energy unit

The invention relates to the regulation of a wind energy unit, especially a doubly-fed asynchronous machine

Previously these wind energy generators were constructed and regulated in ways such as that presented in S. Müller, M. Deicke, Rik W. de Doncker: "Doubly fed induction generator systems for wind turbines - a viable alternative to adjust speed over a wide range at minimal cost", IEEE industry application magazine, May/June 2002. The converter is currently preferably designed as a back-to-back circuit of two self-commutated indirect converters. Each converter is assigned a regulation unit. The corresponding regulation unit determines the switching states of the assigned converter to be implemented and communicates these switching states to the control circuits of the converter. The control circuits are generally integrated into the converter.

The rotor winding-side converter determines with its switching states the currents flowing in the rotor windings. The network-side converter must regulate the direct current to a constant value. The network-side converter can also regulate the direct current for a number of windmills. In this case a direct current network is arranged between a number of windmills. In each case however the rotor winding-side converter is assigned to precisely one windmill.

The invention described relates especially to the regulation of the rotor winding-side converter. This converter is used as an actuator for creating a current system in the rotor windings. This current system defines the active power and reactive power exchanged between the stator windings of the machine and the 3-phase AC network.

By contrast with the known method, the inventive regulation preferably comprises a network voltage analyzer, a commutator and two separate regulation units.

Depending on the state of the 3-phase AC network (faulty or non-faulty) the assigned regulation unit is connected to the actuator (= rotor winding-side converter).

The state of the 3-phase AC network can be determined in the network voltage analyzer, by evaluation of the network voltage at the connection point of the wind energy unit or wind park to the superordinate 3-phase AC network: If the network voltage (or the amount of the network voltage sinor representation) deviates too greatly from an expected value, the 3-phase AC network is recognized as faulty. A corresponding switchover between the regulation units is then undertaken by the commutator, i.e. the rotor winding-side converter now obtains its switching status signals from the other regulation unit.

Conversely a switch back to the regulation unit "for a non-faulty 3-phase AC network" is undertaken if the network voltage measured at the connection point is once again interpreted as "non-faulty", i.e. the deviation of the network voltage from its expected value is back within a tolerance range.

The regulation units thus have the following different functions:

* Regulation unit for non-faulty superordinate 3-phase AC network:

The wind energy generator is operated with a constant power factor (precisely: Basic oscillation shift factor cos $\varphi 1$). The detailed design of such regulation is known from literature.

The power factor demanded by the network operator at the connection point can if necessary deviate from the fixed setting of cos φ1. A separate compensation unit takes care of the adaptation.

* Regulation unit for faulty superordinate 3-phase AC network:
The regulation unit attempts within the framework of the adjustment range of the wind energy unit (WKA) to regulate the network voltage at the connection point to its rated value (= set value). On the one hand this mode of operation allows the WKA to contribute to clearing network errors in the superordinate 3-phase AC network and simultaneously to provide network voltage backup. Both modes are preferred operating modes of the WKA for network errors in the view of the network operator.

One embodiment of the regulation implemented in the regulation unit is as follows:
The network voltage measured at the connection point between wind energy unit and network or wind farm and network is compared to a set value. The difference is evaluated in the network voltage regulator. This regulator can include a drooping characteristic to prevent oscillations between network operating resources. The output signal of the network voltage regulator is the set values for the currents to be fed by the current converter into the rotor windings.

The actual rotor winding current values are compared via a lower-ranking regulation unit with these set values. The switching states of the rotor winding-side current converter are determined by evaluating this regulation deviation.

In the calculations it can be advantageous to use information for angular position and rotational speed of the rotor. Both

can be determined by corresponding additional devices (e.g.: tachogenerator and angle of rotation sensor).